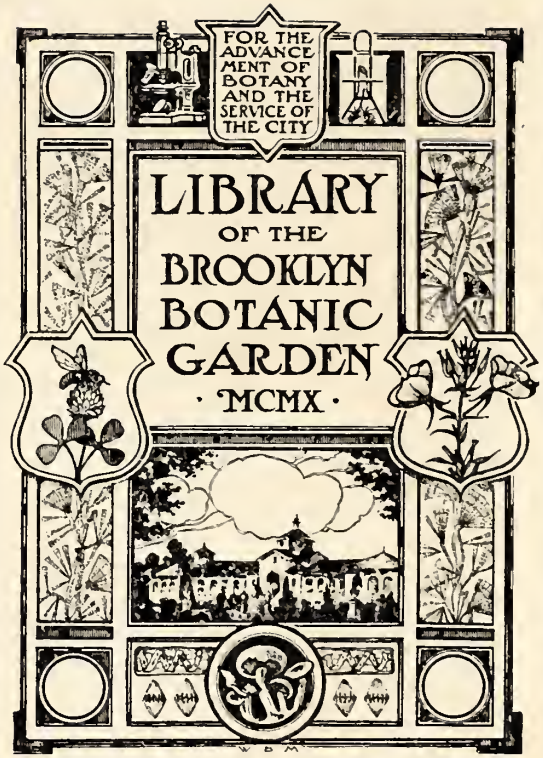
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International Flower Show
Exhibit Number

BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES XXVII BROOKLYN, N. Y., MARCH 13, 1940 NO. 1-2

CARNIVOROUS PLANTS

Exhibited by the

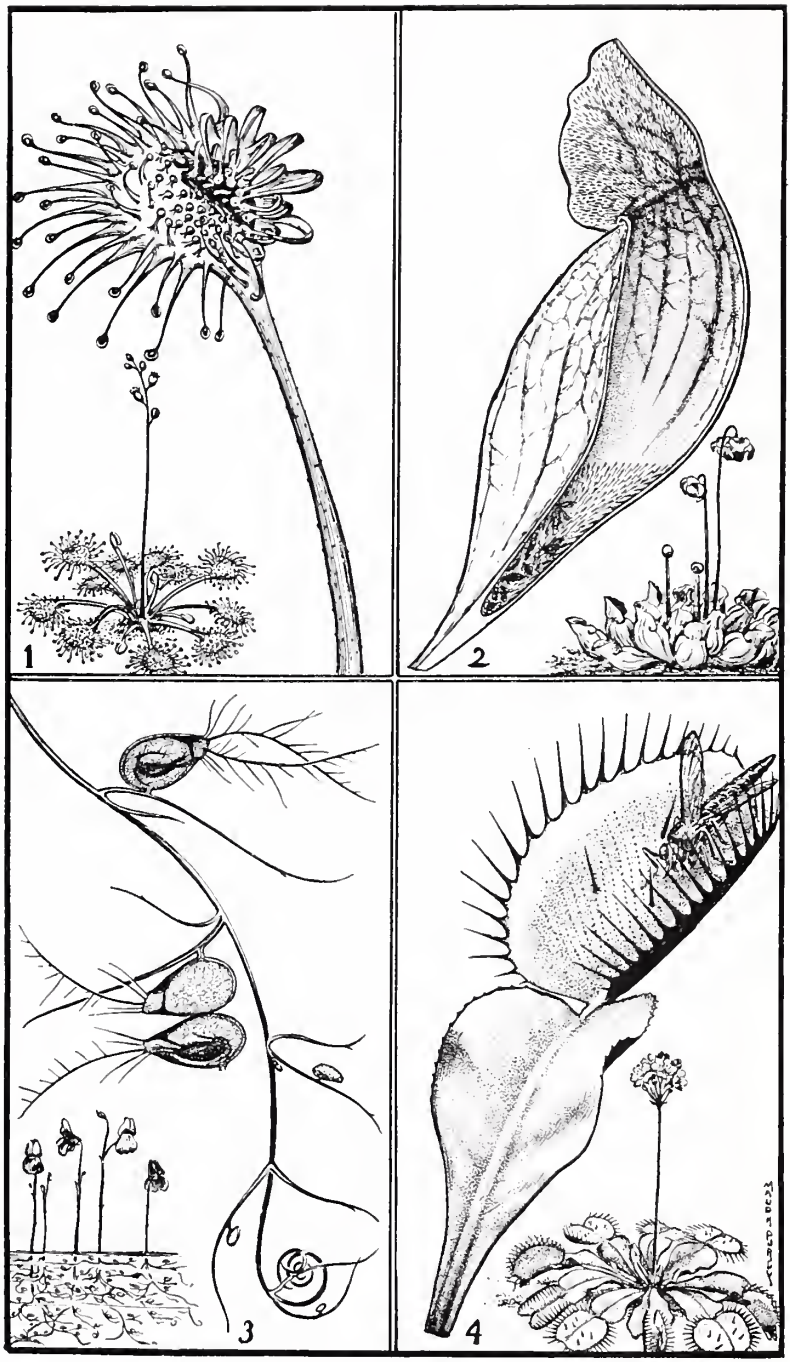
BROOKLYN BOTANIC GARDEN

INTERNATIONAL FLOWER SHOW

MARCH 11TH TO 16TH, 1940

SCARCELY any other subject in the plant world has been so stimulating to the imagination of both the scientist and the general public as these carnivores of the plant kingdom, known also as "insect-eating" plants. They have inspired the lurid stories of man-eating plants which have appeared in sensational newspapers for many years. There are nearly five hundred species of these interesting plants, which become news by reversing the usual "animal eat plant" sequence. They exist in a great variety of form, but because of their comparatively small size they are frequently overlooked. Actually they are much more widespread and abundant than one might suspect. Insect-eating plants have an almost world-wide distribution, but they occur in greatest numbers in moist tropical regions. These carnivorous plants have the green coloring matter in stem and leaves just as ordinary plants do, and their nourishment is to a large extent the same, but in addition they have special devices for trapping insects, small crustacea, and other animals. It is believed by some that these plants, growing mainly in peat bogs where there is a lack of nitrogenous nourishment, may have been aided to survive under such conditions by their accessory meat diet; but on the other hand they can exist in a healthy condition for a long time without being supplied with animal proteins.

The carnivorous plants are not closely related to one another from the point of view of systematic botany, but belong to a half-dozen dif-



See explanation on next page

ferent plant families. Their methods of trapping, however, make them divisible into three general groups. In one group, characterized by the butterwort *(Pinguicula)*, the prey is held fast by sticky substances without noticeable movement of the leaves, although the inrolling of the leaf blade over the victim perhaps shows a transition to the third group. The second group—to which belong the bladderworts *(Utricularia)*, the pitcher-plants *(Sarracenia)*, and the Old-World pitcher-plants *(Nepenthes)*—has leaves constructed in the manner of a lobster trap or the old-fashioned wire rat-trap. In the third type, such as the sundew *(Drosera)* and Venus's flytrap *(Dionaea)*, the captured animals induce irritability which sets tentacles or other moving parts in motion to hold the prey by force. Irritable movements have recently been found in the bladders of *Utricularia*, so that these might be said to be a transition type between the rat-trap type and the type which catches insects by means of tentacles.

The group of insect-catching plants is too large and too widely distributed to be shown in entirety in the Flower Show Exhibit. Except for specimens of Old-World pitcher-plants *(Nepenthes)*, the exhibit is composed entirely of American plants. All, with the exception of the cobra plant *(Darlingtonia)* from California, are from eastern United States. An account of the various plants now follows.

BUTTERWORTS

About forty species of butterwort *(Pinguicula)* are known, chiefly of tropical distribution, although one of the best known species, *Pinguicula vulgaris*, is northern, occurring on the moors of Europe as well as being especially abundant on the rocky northern slopes of the Gaspé Peninsula and extending locally southward to New York State.

Explanation of Plate on Opposite Page

Fig. 1. Sundew *(Drosera rotundifolia)* showing action of tentacles in capturing an insect.

Fig. 2. Pitcher-plant *(Sarracenia purpurea)* with a leaf in longitudinal section.

Fig. 3. Bladderwort *(Utricularia)* with two bladders cut open to show captured animals.

Fig. 4. Venus's flytrap *(Dionaea)* with enlarged leaf showing captured insect and three sensitive hairs.

All drawings are by Miss Maud H. Purdy.

The three species exhibited are from wet pine woods of the southern Atlantic coastal plain. In *Pinguicula pumila* (South Carolina to Texas) the white-to-violet flowers are small; in *Pinguicula caerulea* (North Carolina to Florida) the large flowers are an inch long. The yellow-flowered species, *Pinguicula lutea*, ranges from North Carolina to Louisiana.

All are closely alike in general appearance, bearing flowers on a stalk which rises to a few inches in height from a rosette of leaves lying flat on the ground. The apparatus for trapping animals is extremely simple. It covers the entire leaf and consists of minute bead-like secreting and absorptive glands which glisten in the sunlight. Glands with elongated stalks give out, through minute pores, drops of a sticky substance which constitute the real trapping mechanism. Stalkless glands secrete pepsin-like enzymes which bring about digestion of the trapped insects, which, surrounded by these secretions, are digested and absorbed in from one to four days, depending upon the size of the insect. These glands are probably modified hydathodes (water pores), which also occur on the surface of the leaves and show transition in structure to the absorptive glands. Mucilage from the glands having held the insect fast, an in-rolling of the leaf-edge soon takes place to form almost a cylinder or "meat roll" in which the trapped animal is attacked by the digestive juices. If raw meat juice is dropped upon the leaf the sides of the leaf will move, but such movements occur only a few times, and the ability to roll decreases with the age of the leaf. The hard parts of the insects, wings, legs, etc., withstand the action of enzymes and remain on the leaf after the soft parts have been digested.

BLADDERWORTS

THE BLADDERWORT *(Utricularia)* has either yellow or purple flowers closely resembling those of the butterwort; but it has a very complicated apparatus for catching animals, in the form of small "lobster traps" which occur on the modified leaves at the base of the plant (figure 3). Sometimes these leaves branch into filaments and assume the shape of roots. There are about 250 species, mostly tropical, and they are especially abundant on the coastal plain of the eastern United States, in Australia, and the American tropics. Most of them grow in shallow water. Some tropical species live in damp places on tree trunks, others in the water reservoirs which are found in the leaf-rosettes of tree-

perching members of the pineapple family, or, as the botanist would put it, "epiphytic bromeliads." In some of our native species, such as *Utricularia inflata*, there is a star-shaped rosette of floating leaves which lifts flowers above the water surface. The species exhibited here is probably *Utricularia gibba*, common on the coastal plain from Massachusetts southward, with the leaves much divided and bearing small bladder-traps. The opening of these bladders is closed by a thin scale which serves as a one-way trapdoor, allowing small animals, chiefly daphnids and other aquatic crustacea, to enter, but preventing them from slipping out. Often associated with these scales are branched glandular hairs which secrete a sugary mucilage for attraction. When touched, these hairs cause the bladder to undergo a contraction. On subsequent expansion of the bladder a stream of water comes in and along with it the small crustacea. It is thought that the mucilage tends to kill the trapped animals by blocking their breathing pores, after which secreting hairs inside the bladders give out enzymes to digest them.

PITCHER-PLANTS

PITCHER-PLANTS *(Sarracenia)* — This is a genus of about seven species that grow principally in boggy places in Atlantic North America. Best known is *Sarracenia purpurea*, called pitcher-plant, Indian pitcher, flytrap, sidesaddle-plant, Adam's-pitcher, huntsman's-cup, forefather's-cup, Devil's-boots, frog's-bonnet, and a few other names. A single one-flowered stem bearing a purple flower is sent up from a rosette of leaves which have been transformed into hollow cylinders (figure 2). These leaves have an expanded concave lip mottled with red veins and with accompanying honey glands. The lip is covered with downward-pointing stiff hairs over which the insect creeps along the line of least resistance. Next comes a slippery polished area like an ice-covered roof, down which the insect slides to a watery grave at the bottom of the pitcher. Downward-pointing hairs prevent any escape and, as in the *Pinguicula*, a zone of glands is thought to give out enzymes for digesting the remains.

Rain water comes into these pitchers easily in *Sarracenia purpurea*, but it is difficult to see how it can do so in *S. psittacina* and *S. minor* and in *Darlingtonia*, in which the upper part is hood-shaped. Some observers, therefore, believe that the water in the pitchers of some species may have been supplied from the soil by the roots. There is still

some question as to whether actual digestion of insects occurs in *Sarracenia*, or whether the process is merely one of decomposition and liberation of the nitrogenous material over the base of the plant by decay of the leaves. If this last supposition is true, these plants, in effect, collect and distribute fertilizer for their own use.

The species which are on exhibition are (1) *Sarracenia purpurea*, the most widely distributed species, extending westward to Manitoba and southward to Florida along the coastal plain. This plant is common in nearly all the boggy places of New England and New York, the purple flowers being especially noticeable in June. (2) *Sarracenia flava*, which often covers acres in the long-leaf pine woods of the coastal plain from southeast Virginia to Alabama. With the exception of the white-and-red-splotched *S. Drummondii* (which may not be available for this exhibition), *Sarracenia flava* is the largest species, with the green, trumpet-shaped pitchers and bright yellow flowers rising to two feet in height. (3) *Sarracenia minor*, a little species with hooded pitchers having translucent white spots at the apex. The petals are yellow. It grows in bogs in the coastal plain from North Carolina to Florida. (4) *Sarracenia rubra*, known as the "sweet pitcher-plant" from the fragrance of the flowers, has slender brown pitchers and purple flowers. It occurs from North Carolina to Florida. (5) *Sarracenia psittacina*, parrot pitcher-plant, the name referring to the hood's resemblance to a parrot's head. It grows in lowlands from Georgia to Louisiana. All of these species are characteristic of wet pine barrens, the small species *(S. minor, S. rubra,* and *S. psittacina)* often fringing the large stands of *S. flava.* Hybrids between the various species frequently occur.

The California Pitcher-plant *(Darlingtonia)*, known also as "cobra plant," inhabits mountain bogs in northern California and southern Oregon. In structure it is close to the eastern pitcher-plant *(Sarracenia)*, but the pitcher-top is modified into two downward-pointing flaps. Like *Sarracenia minor*, it has translucent windows against which trapped insects beat their wings in a vain attempt to escape. Contrary to popular opinion, it is not necessary to feed *Darlingtonia* raw meat in order to have it thrive.

Oriental Pitcher-plants *(Nepenthes)* number approximately 65 species and are the largest of the carnivorous plants. Most of them are native to the Indo-Malayan region, Borneo having the largest number of species. They thrive only in regions with heavy rainfall. Some

are species of mountain tops, where they creep about in the moss. Others, especially in the hot lowlands, grow to be bush-like. In the largest species, *Nepenthes villosa* of Borneo, the pitchers become nearly one-and-a-half feet long. The pitchers of *Nepenthes* are variable in shape even on the same plant, sometimes being placed in rosettes at the base of the plant, sometimes on tendril-like leaf stalks on clambering stems. In addition to being beautifully marked with reddish-brown, scarlet, and white, they have a remarkable trap apparatus, not infrequently adapted for catching mice and similar small animals.

SUNDEWS

SUNDEWS *(Drosera)* are common in boggy places throughout northern Europe and in Australia, South Africa, North and South America. They are abundant in eastern United States, especially along the sandy Atlantic coastal plain. The name "sundew" comes from the shining glandular hairs on the leaves, which remain moist and glistening even in strong sunlight. These remarkable leaves (figure 1) consist of a rounded or elongated blade set with tentacles, each tentacle ending in a mucilage gland similar to those of *Pinguicula*. Insects flying about the bog are attracted by the reddish, sparkling leaves and become entangled on the viscous surface. The long outermost tentacles then close over the insect, preventing its escape. As in *Pinguicula*, digestive juices are liberated to hasten dissolution. After the soft parts of the insect have been absorbed into the leaf, the tentacles open out for another victim.

Several species of *Drosera* are found in the United States. The most abundant is *Drosera rotundifolia* (round-leafed sundew), readily found at the borders of almost any peat bog in the northern States. The rosette of leaves lies flat on the ground and from it a stalk with numerous small, white flowers rises. *Drosera intermedia* (also known as *D. longifolia*) is also abundant, preferring mud or silt in very shallow water. The leaves are the same structurally as the round-leaved sundew but are somewhat elongated. A third species, of much more restricted distribution, is the thread-leaved sundew, *Drosera filiformis*, with purple flowers much larger than in the preceding species. It is of restricted distribution on the coastal plain from Massachusetts to Louisiana, occurring abundantly in wet depressions in the New Jersey pine barrens and locally on eastern Long Island. The dwarf sundew *(D. brevifolia)*, in damp pinelands from Virginia to Texas, resembles the round-leaved sundew but has more compact rosettes and pink-tinged flowers.

VENUS'S FLYTRAP

VENUS'S FLYTRAP *(Dionaea muscipula)* is the most spectacular of all insect-catching plants. It is also the most restricted in geographical area, since it is found only in eastern North and South Carolina, over an area extending about 170 miles along the coastal section and 114 miles inland. The leaves lie flat on the ground in a rosette similar to that of the sundew (figure 4). As the leaf unfolds, the end of the blade opens out into two flaps edged with long, stiff bristles and with three trigger-hairs in the middle of each flap. When these sensitive hairs are touched by insects attracted to the reddish surface, the two flaps snap shut, enclosing the insect. Interlocking bristles at the margins prevent any escape. After the insect has been digested, the leaves open again for more food. A single stalk of white flowers rises from the middle of the rosette.

There are several other genera *(Cephalotus, Drosophyllum, Heliamphora*, etc.) of plants which have carnivorous proclivities, but they do not occur wild in the United States nor are they commonly cultivated. Consequently they are not included in the exhibit nor described in this LEAFLET. Those who would like to learn more of this interesting group should consult "Insectivorous Plants," by Charles Darwin, and "Carnivorous Plants and 'The Man-Eating Tree'," by Sophia Prior, Botany Leaflet 23, published by the Field Museum of Natural History, Chicago.

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LEAFLETS

SERIES XXVII BROOKLYN, N. Y., DECEMBER 18, 1940 No. 3

THE CARE OF CUT FLOWERS*

With the increasing amount of attention which is now being given to the arrangement of cut flowers, it may be in order to say a few words about ways of making the flowers last as long as possible. For, when one has succeeded, after painstaking effort, in making a beautiful arrangement, it is discouraging to see the flowers wilt, or soon wither.

Since the primary function of the whole flower is to produce seed, it is wise to prevent the formation of seed, if a continual supply of flowers is desired. And so we keep cutting our sweet peas, violets, pansies, and the like, in order to preclude seed formation, and to be assured, by this method, of a succession of blooms. Flowers cut in the bud stage, or just after opening, will last the longest.

Florists have a trick of removing the anthers (the yellow tips which contain the pollen) from the stamens of lilies; lilies so treated are said to last longer. In general, removing the anthers tends to lengthen the life of the flowers; but some people object to the unnatural appearance resulting from this mutilation.

Because a flower is part of a living plant, the cells of which it is composed must be kept alive and in a healthy condition if the flower is to last well. A healthy condition of the cells means that they are filled to capacity with water. When the cells are thus swollen or "turgid," the petals are firm, not soft and flabby or wilting. A familiar illustration of the firmness imparted by water pressure is seen in the fire hose.

The petals of a flower (as well as all its other parts) are continually losing water to the outer air by evaporation; and this water must be continually replaced if the flower is to keep. In cutting the flower from the plant, we sever its connection with the roots, the organs which obtain its water supply, and substitute for these the water of the container in which the stem of the flower is plunged.

The water which is delivered to the petals is conducted through the stem by bundles of tubes or tube-like cells. When the passage through these bundles becomes blocked in any way, the supply of water delivered to the flower diminishes or stops entirely, and hence the flower begins to wilt.

* This Leaflet is a revised reprint of Series XXIII, No. 2-3, March 27, 1935.

For our purposes, then, we may say that to have fine, upstanding cut flowers, two things are necessary: first, an adequate supply of water, and second (which depends primarily on the first), a healthy condition of the petals.

Although bearing in mind the interrelation of these two conditions, i.e., the conduction of water through the stem and the firmness of flower parts due to their retaining the water, let us enumerate under the two headings the various methods in use for keeping cut flowers fresh.

I. Methods Related Directly to the Conduction of Water to the Flowers

1. In gathering the flowers, use a sharp knife, and make a long, slanting cut. If a dull knife is used, the cut surface may become clogged with particles of plant tissue; and furthermore, a rough, abraded surface is apt to decay more quickly. A long slanting cut is best because more of the conducting cells in the interior of the stem are thus exposed; also, if the stems are cut off at right angles, the cut surfaces may come to rest flat on the bottom of the container and thus hinder the entrance of water into the conducting cells.

2. Use deep containers, so that as much of the stem as possible may come in contact with the water and be protected against evaporation.

3. Leaves which happen to be immersed in the water of the container should be removed from the stem, particularly in hot weather. They decay faster than the stem, promoting a growth of bacteria in the water; and at the same time they tend to crowd the stems too closely. Chrysanthemums, snapdragons, etc. are said to be benefited by having two leaves out of every three above water removed.

4. Cut the stems a little above their ends every few days (a neat, slanting cut), in order to get a fresh surface for entrance of water into the conducting cells of the stem, for these tend soon to become clogged with bacteria and other micro-organisms. At the same time pour out the stale water and put in a fresh supply. Some recommend changing the water daily.

5. Cutting the stems under water is recommended by some authorities. It is believed that the presence, in the tubes, of a stream of water unbroken by air, facilitates the rise of the water.

6. It is said to be good for some flowers, such as Wistaria, Hydrangea, Lespedeza, etc., to have the cut ends of the stems burned before they are put into water. The reason for this treatment appears to be that the cut ends are rendered aseptic, so that bacteria, etc., do not readily enter.

7. For some flowers, it is said to be beneficial to immerse the cut ends of the stems in boiling water for about a minute before placing them in cold water. Some of these are heliotrope, dahlias, hollyhocks, mignonette, and most shrubs, which are difficult to cut and arrange without wilting. The flowers themselves should, of course, be protected from the steam.

II. Methods Related Directly to the Retention of Water by the Flowers

1. The best time to cut flowers in the outdoor garden is in the early morning, for then the cells contain a maximum of water; and then the relative humidity of the air is higher, and the temperature lower than later in the day.

2. After cutting, or after obtaining cut flowers from the florist, it is best to place the stems in a deep receptacle of cool water, and leave them for a few hours in a cool room. Under these conditions the cells of the petals should receive a good supply of water, evaporation will be at a minimum, and the petals should therefore become firm.

3. The room in which flowers are placed for decoration should never be hot and dry; for dry air and high temperature increase evaporation from all moist surfaces. But the air in most artificially heated dwellings is excessively dry. There are numerous appliances on the market for increasing the moisture in the air, such as various radiator attachments, and we strongly recommend using one that disposes of a large amount of water in a short time. The farmer's wife who "has great luck with plants" in her kitchen owes her success very largely to the stream of vapor poured forth all day from the kettle on the range into the air of a moderately heated room.

4. It is a good practice to remove flowers to a cool room at night, or to place them near an open window, if the air outside is not too cold. The flowers are benefited both by the lower temperature and by the higher relative humidity. It is well known that florists keep their flowers in refrigerators.

5. As a rule, do not keep cut flowers in bright sunlight. This increases evaporation and tends to shorten the life of flowers, even though it may not make them wilt at once.

There is scientific proof for the statement that flowers are injured by (what would seem) almost infinitesimal amounts of illuminating gas in the atmosphere. Coal gas is also detrimental. Hence one should take any possible precautions to prevent the escape of these gases into the rooms where flowers are kept.

There seems to be a firmly fixed popular notion that aspirin or salt, when added to the water in which the stems of flowers are placed, will lengthen the life of the flowers. There is no scientific

foundation for this notion. In fact, experiments with several kinds of flowers have shown that such a practice has no beneficial effect. Furthermore, the least bit too much of these substances is definitely harmful to the flowers, in making it harder for them to absorb the water.

Summary

These recommendations may be briefly summarized as follows:

1. In garden flowers which are prolific bloomers constant cutting promotes a constant succession of bloom.
2. The best time to cut flowers in the outdoor garden is in the early morning.
3. Flowers cut in the bud stage or just after opening will last the longest.
4. When gathering the flowers, use a sharp knife and make a long, slanting cut.
5. Use deep containers, filled with water.
6. Remove the leaves which happen to be immersed in the water.
7. Remove the anthers from large flowers, if you do not object to the unnatural appearance.
8. In some cases burning or charring the ends of the stems has been advised.
9. Some flowers are said to be benefited by having the cut ends of their stems immersed in hot water for a minute.
10. Cutting the stems under water, before placing the flowers in their container, is recommended by some.
11. It is best to leave flowers, either those just gathered or those obtained from the florist, in a deep container filled with water, in a cool room for a few hours before bringing them into the living room.
12. Keep the air of the room in which the flowers are used as decoration, as cool and moist as is consonant with comfort.
13. Do not allow bright sunlight to shine upon the flowers.
14. Try to prevent the escape of even a minute amount of illuminating gas or coal gas into the room in which flowers are kept.
15. Do not add aspirin, salt, or any other foreign substance, to the water in which flowers are to be kept.
16. It is a good practice to remove flowers to a cool place at night.
17. Cut the stems a little above their ends (preferably under water) every few days, or every day, and replace the water in the container with a fresh supply.

Arthur Harmount Graves
Hester M. Rusk